HOW TO CONVERT LONDON INTO A GARDEN.

If the exhalations of animals be the food of plants, and *vice versâ*, it is quite clear that plants should be well off in cities could we only get rid of unfavourable circumstances. And, notwithstanding the unfavourable circumstances, many trees and plants do get acclimated in London. And exquisite is the sensation when, from the hot glare in summer time we unexpectedly fall in with a green tree which shades us from the sun's rays by its half transparent green curtain. On the north side of St. Paul's there are a few trees, one of which stretches out almost lovingly a long and slender branch, gracefully waving up and down over the footpath, and fascinating the eye more than all the architecture, the forms of which it enhances by contrast. It is said that scarcely a quarter of a mile of distance exists without a tree in any part of London; though for the most part they are shut in back-yards. But Lincoln's Inn, the Drapers' Gardens, the Temple, and, above all, the small Temple Garden, indicate to us what London might be, and with great advantage to health.

Visible coal smoke, and coal gases not so visible, are the chief impediments to plant growth; and in spite of this, certain trees do grow tolerably healthy. The coal nuisance in the atmosphere prevents the other nuisance from neutralising the growth of our plants. Time was when we resigned ourselves to a smoky atmosphere as a necessary evil; but one day a Parliamentary order, or Order in Council, was issued, that steam-boats and steam-factories—all but the Lambeth potteries—must perforce swallow and consume their own smoke, the fact being not then very clearly understood that a mode of perfect combustion to prevent the generation of smoke was the one thing needful. So boats and factories had to submit and grope in the dark, as they best might, after a solution of the

problem under the coercion of the policeman's persecutions. They were open to observation from the bridges and the river shores, and so most of them took to using smokeless but not therefore gasless coal, and this made some difference in the more prominent parts of London; but the great mass of kitchen chimneys—the grand producers of smoke—remained and remain as before, and probably, with no other motive but coercion to restrain them, would have remained smoke-makers to the end of time, for no Government officials would have compelled them to do that in which they were not competent to instruct them.

Fortunately, self-interest in another direction has led to a simple and easy solution of the problem. The great boiler question, how to consume fuel with the minimum of waste, and also with the minimum of smoke, was long ago solved in Cornwall, where the great cost of coal, by reason of distant transit, forbade a profitable use of it—unless without waste. This was done for upwards of a score of years, and was talked of as a sort of wonder, and not believed in by those who used coal at the pit's mouth, nor by Londoners to whom the cost was far less than in Cornwall. But one Mr. Wicksted, far and wide known as an engineer, having taken in charge the East London Water Works, where the chief business was to pump water to a great height, determined to do it at as little cost as possible for the benefit of his employers. So he visited Cornwall, satisfied himself of the facts, and erected a powerful steam engine at Old Ford, in the locality where once King Alfred changed the course of the Lea river, and set the Danish ships a-dry leaving them in terrorem like other Black Ravens.

The question of preventing smoke is simply that of mixing a sufficient (and not more than sufficient) quantity of atmospheric air with the gases which are distilled in the process of burning. If too much air be supplied, the heat will be carried off in waste, and possibly without generating smoke, just as a very small fire may be blown out and extinguished by too large a bellows. If smoke-producing coal be broken into fine dust, and gradually and thinly scattered on a hot coke fire, the gases will be rapidly distilled, and if mixed with atmospheric air in the right quantity, all the gases will be burnt, producing a bright flame, and the residue will be coke or carbon, which burns without smoke. This is merely the process adopted in Cornish boilers, mechanism being used to sift the coal-dust or small coal on to the fire.

Analyses of cost in processes of manufacture are common. Analyses of cost in the chemistry of kitchen fires is at best a rare process amongst those interested. Fortunately, a very large and influential body have become interested in smoke prevention. The legislature has forbidden the burning of coal in locomotive engines, and specified that only smokeless fuel shall be consumed. The smokeless fuels are anthracite or Welsh coal, and coke. Anthracite disintegrates and falls through the grate bars, and will not answer when violently shaken along a railroad. Coke in many cases costs double the price of coal, and as a ton of coke will not give out so much heat as a tone of bituminous coal, it becomes a very important matter to be enabled to burn coal without smoke, and, consequently, without waste. Many years back this was accomplished by Mr. Dewrance on the Grand Junction Railway; but as the Grand Junction in those days paid eleven per cent., little regard was paid to savings which perhaps involved trouble and opposition. Lower dividends have now made every source of saving desirable, and scores of people have been at work to construct coal-burning locomotives, Mr. Beattie of the South-Western being the earliest in the field. Of course, if the process be complete, that which is simplest and cheapest is preferable. One by Mr. D. K. Clark fulfils these conditions. He makes, at little cost, a novel kind of bellows; an infinitesimal jet of high-pressure steam from the boiler induces a violent rush of air. As many of these bellows or openings are connected or applied above the surface of the black coal through which the gases are distilling, the jet of steam, and consequently of air, is contrived to pitch in any direction so as to mix thoroughly with the gases, in which case combustion ensues. If the mixture be not produced, the cold air may then pass through these tubes without consuming the gases, and with a diminution of steam production. But so perfect is Mr. Clark's arrangement, that by turning off or on the steam jets, smoke may be produced or prevented at pleasure.

What is done in locomotives may be done in house chimneys, by powerful air draughts induced by the chimney. It is no doubt possible to prevent the generation of smoke, if not in open fires, in fires partially closed in a peculiar manner. Fires are required in dwellings to be used in two ways: to produce warmed air, and to produce radiant heat. Both are required in kitchens for boiling water, heating food, baking, and roasting. The latter process cannot well be achieved without radiant heat. Again, in cold weather the general atmosphere of a house requires warming to that extent which is wholesome for breathing; but a greater amount of radiant heat is required for the feet of persons of sedentary habits, or whose circulation is slow. The heat which is pleasant to the feet, would be destructive to the lungs; and the heat which can be borne by the lungs would be almost useless to the feet.

One simple method of preventing smoke, is to feed the fuel from below, in which case the distillation carries the gases through the hot fuel; and there is no reason why this principle should not be applied to kitchen as well as to other fires. But, however, it is sufficient for our present purpose that smoke from bituminous fuel can be prevented; the details are not necessary in this present paper.

We suppose, then, a bright atmosphere—bright as that of any city where wood fuel is used, nay, brighter, for wood also produces smoke very unpleasant in a peculiar state of the atmosphere, as when a log of green elm hisses and sputters at you in Paris in winter time. And now for my gardens. But where is the space? may be asked. So may be asked, where is the space for a garden in an uncleared forest? The space for gardens in a city is equal to that of the whole of the city, less the streets and passages; in short, it is the

whole space occupied by the buildings. So then the buildings are to be cleared away to convert the whole city into a garden? Not so, only the roofs of the buildings.

In southern climates buildings are constructed with flat roofs, as there is no snow, and comparatively little rain. In some cases the roof consists of a floor of canes or sticks, covered with mud mixed with chopped straw. In South America, La Plata, where mist and heavy rain fall at times, flat roofs are constructed by laying first parallel stems of palm-trees from wall to wall, filling the crevices with sticks and mud, laying thereon flat tiles cemented with a mixture of lime, burnt brick dust, and blood; covering the joints with a second layer of tiles, and then again with a third layer. This is impervious to water; and as there are no heavy carts or waggons to induce vibration, this kind of roof does not crack. Roofs depart further from the horizontal and grow more vertical as we go north; and in Canada they get to a steeple form, like that of Westminster Abbey's mountain ridge. Almost too steep for tiling, they use small oblong boards, called shingles, nailed on to them, or they are covered with tin plates, which glisten like eastern minarets in the sunshine. On such roofs snow cannot lie; three inches thickness of snow slides off in a kind of small avalanche, to the annoyance of the passers by.

Steep roofs are necessarily lofty, and are much exposed to damage by wind; and what are called Italian roofs, of much less fall, are therefore largely used; but the steep roofs are truncated in various ways—the apex is sometimes cut off flat, or the height is lessened by making the roof in a series of ridges of the same pitch, with valleys betwen them and around them, involving risk of the very snow they are pitched to avoid, by the overflowing of the gutters, which are a receptacle of the ashes that pass up the chimneys. Smoke nuisance thus helps to increase rain nuisance. Italian roofs, with external gutters, are not exposed to this; but they involve the difficulty, that if a slate gets loose, the trampling of those who have to repair it breaks many other slates, and at a risk of the repairer falling off the house.

To get access to ordinary roofs for the purpose of repairs, there is usually a trap-door in the attic ceiling, where a ladder is placed on occasion. In the roof itself is another trap-door or a dormer, leading out into a gutter so narrow that one cannot walk along it without disturbing the tiles or slates. Apart from the dirt and overflowing of the gutters, these roofs are rarely in order; and the space below the tiles, called the "cockloft"—probably from having been a roosting place for the fowls in the buildings forming the type of the present structures—is a receptacle for soot, dust, filth, and all the bad air in the house ascending from below: add to this, it is usually all in darkness. Few persons know what this really is, till in case of fire, when they know not how to escape, and risk their lives in slipping from steep gutters on their way to a neighbouring house. Those who have ascended the dark wooden gallery in passing through the dome of St. Paul's, may have an idea of it, save that they ascend staircases instead of ladders. Thus a space equal to nearly the whole basement area of all the buildings in London is devoted to filth and risk of life, and an incalculable amount of waste in repairs.

This great nuisance has not passed by unnoticed. The space alone—equal to another floor in a house—is wasted, and this space—supposing the air to be free from smoke—is the purest in the whole house, being farthest removed from the surface of the earth. Attempts have been made to construct flat roofs, but rarely successfully. An architect once showed me his own dwelling, over a part of which he had a flat roof, which he boasted was successful. But in every corner there was a stain, and at last he was obliged to own that the cement would crack from time to time, and required constant attention.

The reason is plain. All flat roofs hitherto constructed have been of brittle material, and brittle material—such as water-cement—cracks from subsidence of the ground; from unequal settlement, from expansion and contraction by heat and cold, and from many other causes.

To guard against this, flat roofs are commonly covered with sheet-lead. But this again is a nuisance. To prevent the lead from cracking by the heat and cold, it is laid in broad stripes, the edges being turned over projecting rolls of timber, sufficiently elevated to prevent rain-water from overflowing. We find every alternate ridge is a table-elevation, or a valley, then a succession of valleys. Such a roof is a nuisance to walk on, independently of the temptation to thieves to steal the lead.

Is it then impossible to make flat and permanent roofs—roofs permanent as a foot-pavement? I think—nay, I'm sure, it is not a difficult operation if set about with common sense. We have for ages made flat roofs to ships at sea—I mean the decks. Planks nailed down side by side are caulked with tarred or pitched hemp. The planks are wet naturally in some climates and artificially in others, and their constant swelling keeps the joints tight. We put wine and liquors into barrels—the wine swells the staves and the liquor does not run out. We put wine and liquors into stone bottles, and we joint the opening with an elastic cork—the cork swells and the liquor does not run out. The difference between these arrangements and that of the flat roofs that let in water is, that in the one case, the materials are elastic, in the others, brittle.

For many years past a valuable building material has been in use; slate sawn or cut into large tables of any required size, from half an inch to three or four inches in thickness. If we suppose four walls to be built up in a square and overlaid with a solid table of this slate, projecting a foot beyond the walls, and with a descending edge to prevent water running underneath to the walls, it is evident that nothing short of a Swiss flood descending the Rhine, and rising upwards, could get access by way of the roof.

But we can't get slates so large! No! But we can get very large slates, and we can put them together so as to be water-tight.

How?

As we joint wine-bottles with corks; cork the

edges of the slates in grooves. They will be very long corks doubtless, but they will he very officient, and will last a very long time, and can be very easily replaced if needful, without the slighteet difficulty of access, and at a very trifling coet.

So now we have got a really flat roof with a alope, say of half an inch to the yard, to lead away the rain-water, and overhanging the wall, with a cornice all round and a parapet some six inchee in height, to prevent rain from falling over or into the street. On thie parapet is an ornamental railing to prevent accidents. Thus there is a flat pavement on the house-top, as flat as the foot-pavement in the street below.

The slates are laid on rafters of iron or wood—or iron and wood—the edges being kept together by iron dogs. But the elatee are only an inch in thickness, and are exposed to heat and cold. Well, the rain and the snow will not affect them, for the cork provides against that. But the room below might be affected. True, so we will ceil that room with lath and plaster, or with a ceiling of thiu slabs; and between the two we will provido for a conetant current of external air in summer, which will keep the room cool enough, and for fixed warm air in winter, which will warm the room and cause all snow to melt on the roof.

Snpposing a range of honses of equal height and the roofs communicating, we should thns ohtain an upper street by which tho inmates of a hurning house might escape, or which they might convert into a garden far more healthy than the enclosures we call squares, or a playground for their children, or in the case of poor people, into a laundry and drying ground. And further, if we hridged over the intervening openings, all London might communicato hy a system of aërial etreets.

But inasmuch as we are not a gregarious people, and most men like to sit down each under the shade of his own something or other—fig trees not being indigenous—it would be quito practicable to carry up thin slate partitions with doors for emergencies. And thus, upon the roof, greenhouece might be erected if preferred to the open air. And probably we should soon eee ivy and creeping plants entwining London chimneys as they do country chimneys, the hoxes in which they might be rooted heing supplied with water from high-level fountains quite as prettily as the Temple court. The water would be better applied than as at present to other and mischievous uses.

These gardens would bo far more healthy than those of the low lying districts round London. We might have a return of the olden time only with the gardene elevated. Instead of saying: "My Lord of Ely when I passed your garden," it would he: "My Lord of Ely, now I mount your garden," and, Hatton Garden would be restored.

And Whetstone Park, that "Punch" mocks at so comically, might fairly look down on Lincoln's Inn Fields.

Think of the wine-parties, snpper-parties, and open-air dinners, that might take place with tho npper crust of London restored to its proprietors! Compare Pump Court, Temple, with the new gardens of Chepe looking on to St. Paul's, and Bow bells chiming; meanwhile men's hrains crooning with old reliques of the merry doings of the olden time, around the crosses of Paul and Chepe.

But now for the drewbacke of "Sitch a gettin' np-stairs." What then? How many of the poor are there who would gladly mount the Monument, could they only get fresh air or the sight of a garden, and especially a garden of their own—not a window garden, but a garden to walk in. And for thoso better off there are mechanical appliances enough, when they come to be wise enough to use them, as instance tho Coliseum in the Regent's Park. Gardens of this kind would be, as in tho East, the resort of the family in fine weather, and in had weather a warm greenhouse on the roof would be a more pleasant thing than a dark parlour. Scarcely anything could be conceived more beautiful than the enormous expanse of London roofe covered with shrubs and flowers. And it would he a perfectly practicahle thing so to construct the greonhouses that they might be open or closed at pleasure. Every honsekeeper might possess his own bit of Crystal Palace, his own fountains, and his own flower haskets, watered not hy hand, but hy art without labour, so that the lady of the house, hy a process as easy as ringing a bell, would effect this object.

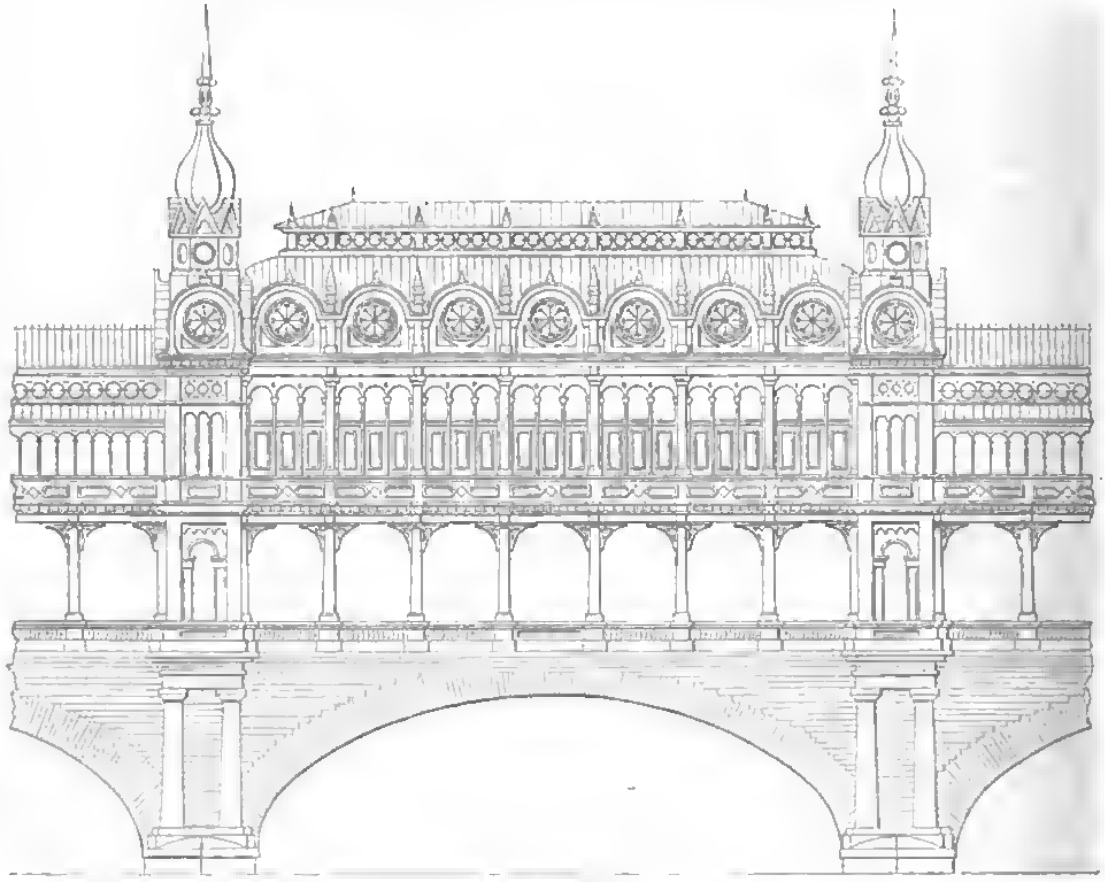
And now as to cost. This kiud of roof, once in demand, would be cheaper than ordinary roofs in first cost, and immeasurahly cheaper in maintenance. The roof would he at least as permanent as the walls. The system awaits only tho riddance of smoke for open air purposee, hut for greenhouse purposes it might be accomplished to-morrow. Every separate house in a row might at once possese what is at present the peculiar luxury of peoplo who happen to possess coroer houses. If a London huildor about to erect a row of four-roomed cottsges, were to adopt euch a system, it would be equivalent to adding another etory as a garden to each honee, with the same outlay, and without increasing ground-rent. If at the samo time ho could arrange his fires to provent them engendering smoke, and carry water on to the roof, he would provide for tho operation of washing and drying without slops in the house. But we must get the legislature at work to compel emokeless arrangements in dwellings as well as in factories.

Looking hack in these pages, they seem so unusual as to read like a romance. Gardens on our housetops! Bahylonisn luxuries! But I am nothing if not—*practical*. And, for my own part, I shall feel greatly obliged to any critic who will demonstrete to me that any part of this proposition is either not practical, or not practicable; in ehort, not a matter of pounds, shillings, and pence, by which landlords may reap profits and tenants reap a large amount of comfort and health.

With flat roofs water-tight as a cistern, and with water laid on to them, and easy of access, the area of London dwellings would be practically doubled; and I may add that such an arrangemeut of roof would be better, cheaper, and moro permanent for railwsy-stations, than the coverings of corrugated metal.

W. BRIDGES ADAMS.

THE WATERLOO PALACE AND WINTER GARDEN.



West Elevation.

One of our cleverest architects, Mr. Frederick Sang, has published a design for converting Waterloo Bridge to a new use, without impeding any of its existing utility. Objections have been taken to this on the ground of its disfiguring the finest specimen we have of stone bridge building. We doubt very much of this disfigurement. The bridge is on the same level as the terrace of Somerset House. It is a massive stone basement, and a light, elegant superstructure would no more disfigure it, than Somerset House disfigures its terrace basement.

The beauty of Waterloo Bridge consists in its massiveness; its straight line of surface, and its broad, solid, and regular elliptical arches. Its defects are, the pier columns which support nothing, and the ugly stone open balusters, which are of no use to look through, and only serve to weaken the parapet, and let wind and rain through to the passengers' limbs. London Bridge is more massive, and, devoid of meaningless ornament, would be a finer bridge than Waterloo, were it only straight in the surface. Waterloo is a finer bridge than London by reason of its straightness.

Mr. Sang's design makes the pier columns subserve a purpose. They carry a superstructure, and at once become useful, the bridge behind them remaining as all stone bridges should do, a solid mass, looking as though the arches were hollowed out of a solid rock of granite.

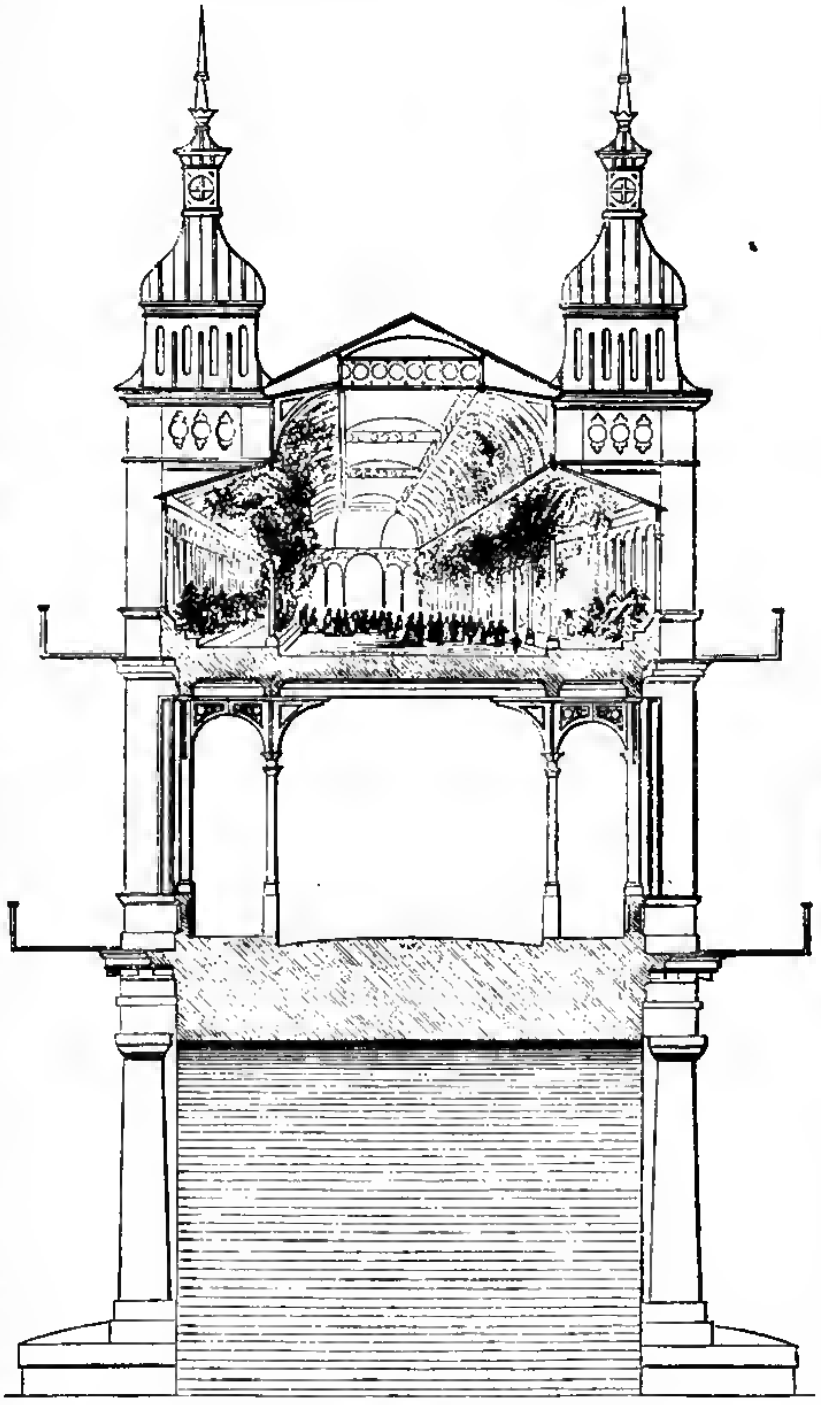
The superstructure proposed by Mr. Sang is of iron, glass, and slate, and elegant in its proportions. Without interfering with anything useful now existing, it creates a new area in London equal to 65,000 feet, or about an acre and a half, having a

headway over the present roadway of twenty-five feet in height, the whole standing on open columns. The whole bridge thus becomes a covered way, free from wet and dust; and, at the same time, without any impediment to the view up and down the river. As a mere promenade in bad weather this alone is a great gain.

The upper story thus gained, is divided into three lengths, the middle being a concert-room, and the north and south ends a winter garden and pavilion. The objection is, that like the suites of rooms in some old palaces, there is no separate communication to the various apartments. There is a simple mode of overcoming this difficulty. By widening the cornices laterally at the present road level, and at the level of the proposed floor above, and converting them into balconies, an area would be gained equal to two Hungerford Bridges, and an open-air promenade for fine weather.

The access to the upper floor is by four flights of steps, one at each angle,—convenient enough; but there is another important thing to consider. When the floor is put on, the reverberation of the vehicles will be something unbearable, if the present macadam pavement be continued. It will, therefore, be necessary to substitute for it wood, or kamptulicon, either of which will be very permanent when kept dry, while the latter will nearly dissipate the sound; and, eventually, be advantageous to the bridge itself, by getting rid of vibration.

Of the utility of this plan, when the Thames shall be embanked and purified, and the smoke of London still more reduced in quantity; when, perchance, the salmon may leap in the glimpses of the moon as they did in the olden time, there can scarcely be two opinions. No ventilation can be more perfect than that near a tidal stream, if pure, and the locality furnishes to mid-London much of the conveniences of a park, the more especially if the Temple Gardens be continued to Westminster, as part of the embankment scheme. The question of cost and profit is another matter, but as a summer lounge and recreation, few things in London would be more attractive or accessible to large numbers of the population. There will be as much and as fresh air to be got at an elevation of forty feet above the Thames tide-way, as at Brompton or Cremorne, and eight to twelve miles nearer than at Sydenham.



Transversal Section.

Some large hotel will have to exist near the site of the Charing Cross Terminus, and lodging houses

appears identical in quality with the explosive oil sold under the name of paraffin, to the damage of a meritorious man who first produced a cheap and safe light for the public under that name. Why the swindlers who take his name in vain, to the risk and damage of the public, by vending a spurious commodity, are not amenable to law is what we cannot well understand. This paraffin, or well-oil, is truly liquid gas, and probably it is to be found in England, as well as in Rangoon, California, the United States, and Canada, only that it is deeper below the surface, and a sufficiently deep boring has not yet been made in the deep pits to get at it. It is possible that in this mode the under stratum of coals might be drained of gas, if not of coal-oil, and the pits thus be made wholesome. Low heat at great depths distils the coal oil, and a greater heat converts it into gas which permeates every crevice, and when allowed to collect in the caverns of the mine kills by violence instead of poisoning slowly; and we may be sure that the safety-lamp which enables people to work in a vitiated atmosphere, if it saves them from violent death, does not enable them to prolong their lives to their natural term. Our neighbours in France make deep experimental borings in search of water. It would be a very desirable thing for us to try deep boring in the depths of our deepest coal-mines to render them wholesome, and probably acquire valuable property in oil-wells.

W. Bridges Adams.

THE REFUSE OF TOWNS AND CITIES.

In every town and city throughout the world, which has not become a desert, a constant elevation of surface is imperceptibly going on. This arises from the fact that more materials are constantly brought in than are carried out. Building materials, fuel, and food, constitute the aggregate aids in this elevation after undergoing the various processes of utilisation. Some of the detritus, such as broken bricks and mortar, are not noxious. Others, as refuse food, human and animal remains, and excretal and many kinds of waste materials from workshops and factories, are deleterious chiefly because they are not removed, or destroyed chemically, so as to remove them in an innoxious gaseous form, or so to fix them as to prevent them forming noxious gases.

From day to day we "grin and bear" our nuisances, complaining of the neglect of the authorities, and wishing for their removal. It rarely occurs to us to consider how much of this lies in our own power, and that the evil might be reduced into a small compass, if we brought common sense to bear upon it. It is a practical fact, that we pray, or profess to pray, "give us this day our daily bread," and that year after year we daily bring into our towns, upon the average, all the food and fuel we consume in the day. Our food we carefully stow away in safes and pantries, light, airy, and accessible; our fuel we put into accessible places; but for the greatly decreased bulk of our food and fuel in excreta and cinders we provide only dust-holes, almost inaccessible without great difficulty. Inasmuch as the bulk is so much reduced, it is clear that the means of transport which brings in the original amount in one day, could with greater ease take away the decreased bulk in one day, and this, whether from a single dwelling, or a great city.

Time was, that every dwelling was provided with what was called a cesspool, *i.e.* a gathering pool, in which ignorant people deposited every kind of refuse, solid or liquid, but in which more sagacious people deposited only solid matter, keeping as far as possible liquid matter from entering, or at least remaining in it. In many towns the ashes of the fuel were used or thrown into this pit, mixing with the night-soil or fæcal matter, and partly deodorising it, and the pit was emptied once a week or month. But in the great majority of houses the term cesspool is a misnomer. The term cess signifies a collection: but the ordinary cesspool, built of the worst possible bricks, uncemented and placed in a porous soil, is not a *collecting* but a *distributing* pit, filling the porous soil with fæcal matter by percolation. In a clay soil the pit is really a cesspool, the clay being non-porous.

Time was, that—in London—these pits or cesspools, were prohibited from all communication with the sewers under heavy penalties, and in some districts hand pumps were used to draw off the liquid contents into the open side drains in the streets, and the solid matter was collected, sometimes for years, because the operation of emptying, for want of convenience, was loathsome, and a nuisance prohibited at all times except at night, hence the term night-soil. This gave rise to the invention of the water-closet communicating with the house drain, and so with the sewers, and the river. An admirable contrivance was the closet—for the rich man living on the upper ground. He could, by merely laying on water, get a cheap transference of all filthy matters. The drains were out of sight, the sewers out of sight; but he was rich enough to pay people for digging them up without suffering the foulness to enter his dwelling. The mere possession of one of these closets was an indication of wealth; and tracing the course of the Stygian stream to its final ending, a foul Serbonian bog, did not enter into the thoughts of the wealthy man.

But time rolled on, and the luxury of the wealthy man grew to be the common practice of the middle-class man. Finally, the owners of all dwellings were required to wash away their excreta into the sewer. Not half London has complied with the enjoinder, and already the Thames

has become a black ditch, and the floating-baths that erewhile served to wash the London population in mid-stream have disappeared. The nuisance that had descended from the dwellings of the rich in water-percolation has turned back upon them in air-percolation. Whitebait dinners at Blackwall cause the gorge to rise with the pollution of the breathing organs.

The Board of Health, as represented by Mr. Edwin Chadwick, had an obstinate idea—a one idea—that cheapness consisted in low cost. Carrying away refuse is a matter of transit, and no transit is so cheap as water-transit. Once on a time a huge mass of mud had collected in one of the reservoirs of a water company. The engineer cubed out the quantities, and the cost of carting away and finding a site for the mud. It was too dear, so the horses and carts were dispensed with, and a number of workmen were set to work to stir up this mud while the water was put in motion, and it was all carried away in the stream—to what place of deposit was not asked.

Mr. Chadwick was delighted with the result, and recorded it, if I mistake not, in one of the blue-books. It got a hold of his mind, and water transit in sewers became thenceforward an idea. All the sewers were reduced, in his imagination, and glazed pipelets of clay were henceforward the be-all and end-all of drainage with constant streams of water running through them. Housemaids were to be enjoined to suffer no scrubbing-brushes to pass into them, and water was to be the solvent for every difficulty.

Now, if, with only half London closeted, the Thames is brought to the condition of a black ditch, what will be the result when the whole is closeted? And what will be the result when the population is doubled? The remedy proposed is this: a large portion of the water which should constitute the Thames is to be diverted from the centre to the sides, and at the outlet the whole is to be deodorised and converted into manure.

That is to say, the whole fæcal matter of London—a comparatively small bulk—is to be diluted to an enormous amount, polluting millions of gallons of water, as if, in that bulky condition, it can be easier dealt with than in its original small bulk, in order to carry out Mr. Chadwick's crotchet of getting the sewage highly diluted for the sake of irrigating the land with liquid manure, like the Edinburgh "foul burn," through glazed pipes; and that, after it is ascertained to be impracticable, and that the deodorised manure must be reduced to the dry condition.

In discussing this question with the most able member of the Metropolitan Board, he remarked to me, that the new sewers are only a remedy for a worse evil, and calculated, at most, for the next twenty-five years, when the increase of the population will defeat their end. If we had to begin *de novo*, deodorising house by house would be the true method.

Most persons have remarked how beautifully clean the streets of London are after a thunder-storm. This is scavenging by nature. Sewers are, for the most part, a contrivance to defeat this kind of scavenging. By sewers are to be understood deep underground drains, only accessible by passing through them. By surface-drains are not necessarily understood open drains, but drains following the natural inequalities of the surface, and which may be provided with covers to render them easy of access. Storm-waters might thus be carried off and permitted to enter their natural exit, the river, wherever a river exists. There is little in the surface-washings to affect the natural streams.

Everything tending to putrify in the streams should be kept out of them. So also everything tending to clog the channel should be kept out. We do not throw ashes into the river, for this latter reason. Obnoxious matters are produced in dwellings and factories. Factories give refuse such as gas-water, and similar matters, well known as "blue billy," surreptitiously discharged into the river, and giving out the poisonous gas, sulphuretted hydrogen. Dwellings furnish solid liquid fæcal matter, soapy and other water, containing refuse vegetable matter. Soapy water might without drainage pass into the river as innocious sewage. Vegetable water needs deodorising as it passes away, that is, putting into a condition in which it will not give off gases, precisely as is now largely done with the refuse of gas-works. With one exception the chief difficulty is the fæcal matter, and that is as noxious as the gas which permeates the earth below the streets leaking from the pipes, mixing with the sewage, and helping largely to pollute the river.

Gas is passed by pressure through a large extent of cast-iron piping of small dimensions. It has been said that it permeates the metal, but it certainly permeates the joints, and so escapes. The screw threads corroding in the pipes, the vibration of the passing vehicles shakes out the rust, and the gas goes out through the loose earth. This waste—a very heavy per-centage—raises the price of gas proportionately, at the same time that it lessens our supply of light and lowers our health, sometimes killing us outright by explosion or inhaling. The whole under-stratum of the streets and houses is saturated with this waste gas, which is in many ways reconverted into the sulphuretted hydrogen it was before the lime purified it in the process of manufacture. Do we need proof of it? Hang over the street gratings or on an up-turned pavement; watch the black earth surrounding every pipe, probably more noxious than the burnt camille snuff from which the advent of gas freed us.

The obvious remedy for this evil is to cease burying the pipes in loose earth, which only serves as a bad kind of "puddling," and to prepare accessible channels wherein they can be examined from time to time, and repaired without disturbing the paving, and wherein they need not be taken up or disturbed, or have their joints broken by the vibration of the vehicles. This practice of burying our water and gas and sewage pipes in the ground in inaccessible darkness is an ancient ignorance unpardonable at the present day, involving costly waste and more costly disease.

But the great source of river and drain nuisance is the fæcal matter of our dwellings. This is divisible

into fluids and solids. The solids are the fruitful source of poisonous gases, yet it is demonstrable that if the solids be kept from moisture they evolve no gas whatever. A large trade is carried on by drying them and packing them, most probably in the identical hogsheads which bring back sugar from the West India Islands, which receive this dried matter as manure. "Well," said Lord Palmerston, "dirt is only matter in a wrong place." That which is dirt in London, becomes sugar in the tropics. Of the value of these matters for purposes of manure, there has probably been much exaggeration; but of the importance of expending considerable sums on destroying or getting rid of them there can be no doubt, and against the cost of any newer or better methods there is always to be set the cost of the present system of sewers. If we can utilise them in value while destroying their noxious properties, so much the better; but the great consideration is how to destroy the nuisance.

On the pampas of southern temperate America, the prairies of northern temperate America, and in sundry table lands to boot, fuel of wood or coal is a very scarce commodity, and the chief resource of travellers is called "bosta" in the south, and "huffalo chips" in the north: it is, in short, dry animal manure. When in sufficient masses a pleasanter or better fire never warmed an Irish cabin on the edge of a peat moss. Here is an indication of one means of disposing of noxious matter, not polluting thousands of gallons of water in a vain attempt to move matter from one "wrong place" to another, but applying the universal cleanser, fire. Placed in close retorts as we use coal to distil gas, this matter also would distil gas almost identically the same, leaving as a cinder not gas coke but a more valuable article—animal charcoal. The whole question in this case is a different mechanical arrangement in our dwellings, not difficult to imagine or construct, separating fluids from solids—in short, a retort for a receptacle to which the application of gas or fuel in another form might be made at pleasure. The water-closet would become a fire-closet with chemical arrangements to fix the noxious gases. The chemical world is largely at work upon the process of deodorisation, and it will be accomplished. The chief error lies in trying to deodorise with a thousand-fold dilution. Let the chemists apply the deodorisers in small bulk, and the process becomes easy. It must be done house by house by a process simple and easy, within the servants' control, and, in order to ensure success, yielding a perquisite to the servant in a similar mode to the grease-procuring process of the cook, and in such case it would never be neglected. If the value be anything like that assumed by the Chadwick school of water transit, it will be very largely increased by keeping it in the concrete state. Of the effects of water dilution we have examples in our river docks, which act as cesspools for twelve months together, and, in the summer, when the heat renders them unbearable, vomit forth their contents into the river.

We have another example in the town of Croydon, which, after a long experiment in Chadwickian pipe-drainage and enormous dilution, is washed tolerably clean, but can find no exit for its polluted waters, the authorities trying place after place, and being encountered by Chancery suits; at one time polluting the Wandle stream, but driven back thence, are now in despair of finding any outlet for their liquid manure, and the parish likely to be ruined in law. Why do they not deodorise? Probably because the huge bulk renders it impracticable.

Thus Croydon gives us on a small scale a foretaste of what is likely to be the result of the huge brick tubes leading to Erith.

Preventing the access of air and moisture is the true method. This may be done in many ways. There is one obvious method adapted to the sick room or the hospital which may probably be in use, but I am not aware of it. It is well known that flesh meat dried, and covered with peat or butter, may be preserved fresh for any length of time. If coal oil, or paraffin oil, Rangoon, or any of the hydro-carbons, natural or artificial, be floated on the surface of decomposing matter, it will arrest decomposition as surely as the Egyptian process of embalming dead bodies. And this oil, wholesale, scarcely exceeds in value one shilling per gallon. It would therefore be practicable to use it in dwellings in small quantities instead of the enormous water dilution.

The water idolators will scoff at all this, and ask how all the dwelling arrangements in London are to be changed to meet these conditions? Our answer would be, has not a large alteration from cesspools and distributing pits to water dilution already taken place? and how? Simply by making a commencement—setting a pattern. Getting rid of the dilution is a much more easy thing than creating the dilution, for it gets rid of the underground complication. There is amongst house-agents a standing jest about a lady, who "wanted a house without a drain." There was more common sense in her words than probably she herself dreamed of. She really wanted to get rid of underground "black ditches" as well as those on the surface.

It is not every town that is blessed with a Thames. Birmingham, for instance. Birmingham is a town of cesspools, but Birmingham has always been free from cholera. After their fashion they mix coal dust and cinders with excreta, so that a clumsy partial deodorisation takes place, and the matter is put in a *right* place, *i. e.*, on the land. Moses in the olden time enacted that every man should have a spade on the end of his spear to dig and cover up nuisances in the camp.

But how to destroy or render harmless the excreta of all London is the question before us. Not in a single day can it be dealt with, nor in many days; but a beginning might be made. An individual might try a single house; a building company might try a number of houses, induced thereto by the consideration of getting rid of sewers rates for all time. If the legislature would consent to this compromise, and the fact were once demonstrated, the process would spread without much trouble.

There are localities where the experiments could be fittingly made: for example, the camp at

Aldershott—a town in miniature without a river, and in a comparatively primæval condition. It could there be ascertained whether it is not practicable, by the dry chemistry of fire, and at very moderate cost, utterly to destroy the nuisance, while leaving a marketable residuum of little bulk and easy transport — this as regards the solids. As regards the liquids: undiluted, there would be little difficulty in dealing chemically with them, extracting the valuable salts, and suffering the innoxious filtered liquid to flow away. This would be a valuable boon from a government to a nation, putting "matter in the right place," and showing that what holds good of a camp or a temporary town holds good also of a city or permanent town.

There are four methods to try:—First, to destroy the nuisance by fire. Secondly, to neutralise it by chemical action. Thirdly, to inclose in oil or analogous material, so as to exclude the atmosphere. Lastly, to keep the solids and liquids apart in all cases, and to cease from multiplying the evil by enormous dilution, the results of which we experience in the condition of the Thames.

As regards immediate action, we must pay the penalty of our ignorance in converting the Thames into a cesspool. In the blue books of the Board of Health the sewers were denominated "elongated cesspools." Under diluvian guidance the Thames has become an open black ditch for the reception of their contents, blocked up by the incessantly returning tide—the protest of the ocean against pollution.

Nature helps us. With the thermometer at 80°, the acetous fermentation of the river commences, and goes on to the putrefactive, converting into unsavoury but warning gases the excreta lying in the channel of the river, and so the nuisance is gradually carried away by the atmosphere. If the warm weather lasted long enough each summer, and the supply of matter were cut off, the Thames would become pure, as it does in casks or tanks on shipboard,—horrible to every sense while the fermenting process is going on, but pronounced by all skippers frequenting the Thames harbour as the finest water in the universe when the gases are thrown off and the no longer fermentable mud subsides to the bottom—a thing almost incredible to those who have not witnessed it.

And yet some millions are to be given to engineers to expend in huge high tunnels to form a temporary safety-valve for London, while chemists and engineers are studying the processes which will ultimately render the tunnels useless, after a plentiful crop of litigation on the part of the inhabitants of the outfall regions—the present Croydon process on a gigantic scale. Well; we are a rich nation, and prefer the impracticable methods which we call practical to logical inference leading to probable experimental verification. We prefer arriving at the processes that will do by going in succession through all the processes that will not do.

It is not creditable to our common sense that it should be needful to discuss such a question in public journals. It was a maxim of the elder Bonaparte that "dirty linen should be washed at home." That is, the dirt kept out of public view: but the nuisance has endured so long that, perforce, it must be talked of in public in order to get the public to understand it, and to enforce the needful change. W. BRIDGES ADAMS.

THE WATER STOPPAGE.

HUMAN beings in the aggregate have, in some things, a strong resemblance to sheep. If a flock of sheep be driven along a narrow passage, and a stick be placed across it to impede the way, the leading sheep will leap over it, and all the following sheep will continue to leap at the same spot, even though the stick be taken away, and the necessity for leaping ceases. It is the sheep's mode of showing respect for the principle of "red tape," which seems to be a kind of universal fungus overlaying all nature, when not carefully rooted out like "quoitch grass."

In all countries where winter's frost exists, and where water is supplied to houses artificially by pipes—save perhaps in Iceland, where the Geysers supply water with the chill off—it has been from time immemorial the rule to have pipes burst and flood houses in winter. The proximate cause of this is still water—that is, water, not flowing—left in the pipes. In New York, the Croton River is made to flow over the city at the summit-level, and so gravitate downwards through pipes from top to bottom of the houses,—by dint of constant observation, it is probable that the Croton water company arrived at the fact that running water generally does not freeze, so as soon as winter sets in they send forth a recommendation to their customers to keep their taps constantly running. Those who follow their recommendations are freed from all difficulty, save that of the bubbling crystal, which, though suggestive of pleasant associations in summer, becomes mere noise suggestive of shivering in winter, and so the thoughtless-minded, with a *morale* on the level of that of Red Indians, preferring present pleasure to future comfort, stop their taps and burst their pipes.

But in London and other English cities "water is water," and it would be a very difficult thing to get the water companies to issue a circular to their customers recommending them to run the water off in waste, simply to save cost and annoyance to those customers at the company's expense. So for the natural means of stopping freezing by keeping up a current, we must apply some simple artificial means. But let us begin at the beginning. Why do the pipes burst?

Simply in conformity with a law of nature whereby water frozen occupies a larger bulk than water in the state of liquid, and if confined in the liquid state and then frozen, it will burst the vessel which contains it. It is this process that bursts rocks, and breaks down mountains, and pulverises the clay soil of the farmer, and bursts metallic pipes. Take an Enfield rifle barrel, stop up the

vent or touch-hole, place it vertically, and fill it with water on a frosty night. As the water freezes it will flow over at the top and cover the outside with ice, and the barrel will remain uninjured. But if, after filling with water, a metallic plug be screwed fast into the muzzle, the result will be that the barrel will burst, and most probably along the curve of the grooves or thinnest section. If an old "Brown Bess" be treated in the same mode, it also will burst, and probably along the course of the weld or junction, commonly the weakest part.

The cause of bursting is, that the water is confined and has no room for expansion. If the lead pipes commonly used for water be made of pure soft lead they may possibly stretch and yield to the expansion without bursting, but if there be an ordinary solder joint made of brittle metal, there probably the burst will take place.

Time was, when water was more plentiful, or the consumers fewer in number, that it was allowed to run to waste. But a self-acting arrangement was invented to save the water when the cistern was full, gradually closing the supply pipe, thus ensuring its being left full of water for the frost to act on and burst it. Probably "ball-cocks" have done more to burst pipes than any other arrangement connected with artificial water supply. Shrewd people tie up their "ball-cocks" during the frost, and let the water overflow by the waste pipe till it is turned off; and, supposing the "ball-cock" to be the lowest point of the supply pipe, this arrangement is effective, but it sometimes happens that the pipe bellies down lower than the "ball-cock" and remains full of water, in which case bursting may take place notwithstanding.

The freezing of the water in the pipe can, of course, only take place when it is exposed to cold air or is laid too near the surface. Haybanding and other contrivances are resorted to with more or less effect; but an effective, permanent, and self-acting plan is needed. Several modes might be adopted, but in all cases the objectionable plan of building the pipes into walls, so as to be inaccessible, should be avoided. One method would be to enclose the supply or service pipe in a wooden box, or trough, six or eight inches in diameter, and pack it round with ashes, or a cast-iron pipe in halves might be used. And there might be left a mere open space round the pipe with access to warm air from the kitchen range. But this supposes relaying *ab initio*. In the mass of cases the question is, how to apply a remedy to existing practice? In houses where gas is burned this may be accomplished by attaching a small copper cistern at the lowest point of the supply pipe, and keeping a gas-jet burning in contact with it during the duration of the frost, the pipe being duplicated for a yard or two in length in a rising loop, to keep up a circulation, in which case freezing cannot take place. Where gas is not laid on, an iron tube may be connected with the supply pipe, with a closed end placed in the kitchen boiler, which may be shut off when frost does not exist.

When all is done that can be done to prevent the bursting of the pipes, there will still be an element left to deal with of an uncertain kind—thoughtless people who will forget to light the gas-jet, or to open the communication with the boiler, till put in mind of it by the stoppage of the water supply, when the evil is done. The pipes burst during the freezing action, but only become apparent in flooding the house when the thaw comes.

Upon the whole, it would be for the interest of the companies to provide that the supply pipes from the main to the cistern should be kept at the proper temperature, and thus preclude the results of carelessness. A hollow watertight space round the supply pipe, communicating with the warm air of the kitchen, would need no care on the part of the tenant. The cost of repairing and drying one drenched house would more than pay for such an appliance. And we only heal the apparent evil, not the remote one. I knew an instance of a house being flooded with water in the process of conveying engine-hose through it to put out a neighbouring fire, and the result was, that four months afterwards the whole family were attacked by ague as effectually as though they had lived in an American swamp.

W. Bridges Adams.

MR. TRAIN AND THE BAYSWATER TRAMWAY.

Per favour of Rowland Hill, the present writer received a pink-coloured invitation to inspect this system, and afterwards adjourn to St. James's Hall to a "turtle lunch." The ticket of invitation was unique in its kind, containing a list of guests some three feet in length and some eight hundred in number, and amongst them Mr. Train invited himself, the whole of the Press Periodical and sundry of the Press Erratic, Bank of England directors, and dignitaries, or pseudo-dignitaries, of many kinds, whatever might be the weight of their avocations. Colonel Anderson of Port Sumter, Don Jose Salamanca, Holman Hunt, Thackeray, Dickens, Paxton, and Peto, the Marquis of Westminster, Dr. Charles Mackay, Poet Massey, and Brassey, and Pliny Miles, author, — and

soldier-philosopher of course,—were all mixed up togetber in admired confueion. It was an injustice to leave out the Man in tbe Moon, the Emperor of China, and the King of the Sandwich Islands.

A railway friend accompanied the writer to this so-called tramway, stretching one mile west from tbe Marble Arch. It is not a tramway, but a railway with an edge rail, flanged wbeels to run on it, and points and orossings to turn out of one line on to another, and a siding to enable carriages to pass each other, as on ordinary single lines of railway.

The rail is a flat bar of iron, five incbes wide, one incb thick on eacb edge for tbe widtb of an incb and a half, and half an inch thick in the middle. The rail is spiked down to a longitudinal timber of its own width and eight incbes deep, and the longitudinals are kept in gauge hy timber crossties at frequent intervals, to which tbe longitudinals are spiked by the aid of iron corner plates. The total depth from the top of the rail to the bottom of the crossties is fourteen inches. The carriages are omnibuses, witb seate wider than common, the passengers seated side hy side as usual, and with space enough between for a row of stand-up passengers when traffic is ebundant. At each end is a projecting gallery, with side entrances. In the front gallery the driver stands, dressed in rifle uniform, and driving a pair of horses in the attitude of a classic charioteer. In the hind gallery stands a rifleman conductor, wbo at present rifles tbe passengers of their cash at tbe rate of two-pence per mile—douhle the rate of the ordinary omnibuses, and as many passengers as can, or will, stand in tbe galleries by the side of tbe riflemen. The carriages, regarded as travelling apartments, are well constructed, ligbt, and well ventilated, for which tbe through passage gives them a great advantags; but as a pisoe of mechanism intended to run light, they are very defsotive. Tbe wheels are of cast iron, disc form, 2 feet 9 inches in diameter, and hard-cbilled on tbe peripheries, bnt are very narrow, and are keyed fast on the revolving axles, precisely like railway wheele, with all tbeir disadventages, and more than their friction, as tbe narrowness prevents any lateral play on coned surfaces, to compensate for curves or irregularities. The eprings are mere lumps of vulcanised indiarubber, resting on the axle boxes, with eligbt vertical movement. The motion is tolerably easy, and will be while the road is in order, hut will not be when the road gets out of order; but the grind and ring of tbe cast-iron wbeels is not pleasant. There is, moreover, a great mechanical mistake in construction.

The rails, as at present laid, are supposed to answer two purposes: the portion elevated half an incb is for tbe rail carriages, to be guided by the wbeel flanges; tbe flat portion, three and a half incbes in width, is supposed to be a tram for ordinary wheels to run on. If the wbeels are of the rigbt gauge, this may be done; but the attempts of various cab-drivers to drive on them were far from successful. The raised rail is not sufficiently elevated to keep them on tbe track as a guide, and considerahle skill would be required to drive in a straight line upon them, even with a two-wbeeled cab, and with a four-wbeeled cab or omnibus still more difficult.

It is a mistake to have kept the rail only half an inch in elevation. It would have been no greater impediment to ordinary carriages, had it been bigher; and it is also a mistake to have attempted making a tram with the same rail. The tram is of no use unless seven to eight inches in width, so as to allow free lateral play for the wbeels. The object in making the plate five incbes wide is to prevent bending laterally by tbe blows of wbeels of vehicles crossing the road, but the vertical thinness will expose it to bend vertically under beavy vehicles, and the engineers have yet to find out, that as road rails are exposed to a greater violence than railway rails, tbey must in some way be guarded or made etronger. If this Bayswater line is to have any durability, it must be bordered with stone kerbs, or some otber material, better than Macadam, or tbe wbeels of ordinary vehicles running along tbe edge will cut deep grooves, in which weter will lie and penetrate to the foundation, and it will not do to open np the road to pack ballast, as is done on the railways. If tbe timber springs in tho ground, it will be a constant source of annoyance, as it will be if it rots. It is creosoted timber, but there are two kinds of croosoting, one which penetrates throughout, and one which merely dies the surface skin-deep There is anotber mistake: the wheels are Americen, and tbe rails are Englieb, and the wheel flanges are of greater depth than the rails. The result is, that the wheels run on tbe tbin centres of the rails, and will bend them into hollows. As the flanges grind down, the wheels will bear on two several eurfaces of different diameters, and tbe result will be that every wbeel will act as a brake, whicb tbe borees will soon find out, to the cost of their owners. And it is curious to find that a patent bas been taken for so especially bad a form of wbeel and rail, *i.e.*, a wheel which is to run either on rail or common road, and badly on both.

One advantage in the new carriages is the arrangement of hrakes to stop the carriages without borse-power, eitber to take up or set down passengers, or in descanding inclines; but there would be obviously no difficulty in spplying hrakes to tbe ordinary omnibuses, and the only wonder is that it has not been done already. The principal reason for this omission is, that conductors and drivers prefer the work to be done by the borses.

Tbe advantege to be obtained by tbe system is, if anything, a better road to run on. From this point of view, then, we bave to compare the Bayewater rail with the Beyswater road. The rail is a hard eurface, hut is liahle to dirt. The road in good Macadamised condition is also a hard surface, also liable to dirt. The rail has lateral friction, the road has not. On the road, large sized independent wbeels run; on the rails, iron rollers of small diameter run, and upon the wholo it is douhtful if tbe rail as laid and used bas any advantage other than guiding the vehicles, witb the disadvantage of the wheels being quite useless off the rails.

There is an important advantage in the rails over the Macadam. Rightly constructed and laid, they would cost far less in maintenance. The Macadam is a crumbling substance, the iron is durable; hut the utmost that can be expressed in favour of the present sample at Bayswater, comes from the lips of one of the engineers: "It is a step in the right direction," a cant phrase now applied to all sorts of inefficiency.

The objections made by the inhabitant of Connaught Place—that his horses will slip on going into the park—can only have reference to the broad space occnpied by the points and crossings, and the double line of rails. There is nothing in the ordinary line to affect this question, provided it were properly bordered with stone. It is e great thing to get it experimented on, and it is to be hoped that the defects it exhibits will not be taken to be essentials of the system.

The examination being over, the writer accompanied his railway friend to the "turtle lunch," though what the lunch had to do with the Bayswater rail was not very definite; hut, as there were to be five-minute speeches, with Mr. Train in the chair, it was probabls that some useful information might be given. At any rate, there was Mr. Train to be seen and heard, and the press had spread his fame far and wide.

Is it lawful to eat turtle, or see turtle eaten, at St. James's Hall, and then criticise the founder of the feast? On the whole, it is probable that, as the feast was devised for an advertisement, the notice of the feast in tho press may be regarded as a natural concomitant, agreeable rather than otherwise. Mr. Train was certainly the great feature, and such sn amount of excitement in a man who is reported to be a teetotaller is rarely witnessed. He puts us in mind strongly of Alexandre Dumas. Why he should advocate tramways especially, no good reason appears, for there is no doubt that he could advocate anything else just as well. Mr. Train is not a rhetorician, still less a logioian: hnt assuredly "those lips are well hung that can keep so large e table in a roar." He certainly does not belong to the dull Anglo-Saxon race, nor does he epeak with the drawl of New England. The mercurial Celt, French or Irish, is a strong element in him, mingled with much geniality from other sources, and he appears to care little what he says in quality, if the quantity be sufficient. There is in him no lack of the accompaniment of oratory—action, and his own sensations of mirth carry away his hearers with him. Men of Mr. Train's faculties seem to be an Institution of Speculation, and so belong to the public. His langhter is catching, and every one laughs without knowing why. There is humanity about the man and his everlasting hilarity. When he gave the toast of Queen Victoria, she seemed to be his own natural sovereign, and the Prince Consort and the rest of the Royal family were all members of his own family. Equally genial was he with the President of the United States, though some of the guests murmured—

"Under which king, Bezonian?"

Masterly was his introduction of his patrons. "The Press, as the next power in the world to the sovereigns," and "The Metropolis Board of Works," took rank before the whole of the Government, after which came "The Anthors and Artists." "Corporations, the givers of Tramway Concessions." Army, Navy, and Volunteers. All very pleasant and laughable; but not yet a solution of the question, how best to construct rails in the streets and roads of the metropolis and elsewhere.

W. BRIDGES ADAMS.

PATENT GHOSTS.

Perceptive faculties, and the want of them, constitute a very large part of the difference between the progress and non-progress of humanity. Those who possess perception are the great purveyors for those without it. The great mass have eyes, but they see not with them till they fall into the hands of guides who direct their vision. Why should not the guides be paid for this, as much as the Swiss guides who take people up Swiss mountains? There was a time when the world was ignorant of the optical effect of two strips of glass, placed edgewise together, to form a hollow prism, till Sir David Brewster patented the matter, and gave the kaleidoscope to the world.

The principle of Mr. Pepper's popular Ghost is the same that produces giant shadows projected on mountain mist; and thousands of shadows of this kind may be seen between sunrise and sunset throughout London streets every day; but as they happen to be common objects, nobody heeds them. But a ghost, or gaseous vapour supposed to resemble a human being after death, excites most people's imaginations more or less morbidly, and when Mr. Pepper used a common principle to produce a ghost, all the world ran mad, and the process of producing this ghost became a valuable source of profit for public exhibition. If amusement be a good and useful thing, Mr. Pepper has done good service to the community. At all events he thought so; and therefore, in concert with Mr. Dircks, he applied for a patent on the 5th of February, 1863. The application was opposed, for the exhibition was a very profitable one, and every proprietor of a theatre or exhibition was interested in not paying a royalty for what was so very simple, after it was once pointed out. Any number might assert their previous knowledge of an invention which existed everywhere spontaneously, and so up to this day no patent has been granted: whether on the ground that it is an abstract principle and not a subject of manufacture, or whether on account of disputes between claimants, does not appear.

In October, 1858, Mr. Dircks contributed to the "Mechanics' Magazine" an article, in which the optical principle was described, and herein is evidence of the importance to the public of giving

individual proprietorship, in order to get a thing into public use. Of the hundreds of people who must have read the paper, not one sought to apply it and turn it to purposes of use or profit. But the Polytechnic was in want of novelty—something to draw—and so Mr. Dircks and Mr. Pepper laid their heads together to produce a ghost in broad daylight. Like the egg of Columbus, everybody knew how to do it after showing. Had the patent been quietly applied for before making a stir, probably it would have been granted, and we think that Mr. Dircks' previous article, five years before, which the public failed to recognise or adopt, should not have been any bar to the grant. Had the public used it, Mr. Dircks would not in equity have been entitled to revoke his gift.

But there was an older giver than Mr. Dircks. In the library of the Patent Office, gathered together by the diligent, loving labours of Mr. Bennet Woodcroft, there is an old black-letter folio volume, entitled "Porta's Natural Magick," with an engraved portrait of the author, a Neapolitan, and apparently a friar of the Bacon stamp, surrounded by emblems of the four elements—Fire, Air, Earth, and Water, with a curious "Chaos," from which they spring, and a figure of a very bounteous "Nature," with three pairs of breasts. This volume was printed in London, for Thomas Young and Samuel Speed, at the "Three Pigeons," and at the "Angel," in St. Paul's Churchyard, in 1658, being a translation from the original Latin edition, first published at Naples some seventy years previously. The following is an extract:—

How we may see in a chamber
Things that are not.

I thought this an artifice not to be dispised; for we may in a chamber, if a man look in, see those things which were never there; and there is no man so witty that will think he is mistaken. Wherefore, to describe the matter, let there be a chamber whereinto no other light comes, unless by the door or window where the spectator looks in; let the whole window, or part of it, be of glass, as we used to do to keep out the cold, but let one part be polished, that there may be a looking-glass on both sides, whence the spectator must look in; for the rest do nothing. Let pictures be set over against this window, marble statues and such like; for what is without will seem to be within, and what is behind the spectator's back, he will think to be in the middle of the house, as far from the glass inward, as they stand from it outwardly, and so clearly and certainly that he will think he sees nothing but troth. But, lest the skill should be known, let the part be made so where the ornament is, that the spectator may not see it, as above his head, that a pavement may come between above his head; and if an ingenious man do this, it is impossible that he should suppose that he is deceived.—Chapter XII., p. 370.

No doubt, the Egyptian priests understood this earlier than Italian friars, and the Hebrews raised up "lying spirits" in the same fashion.

This very day I have seen some hundred ghosts, and scores of people saw them with me, though not consciously. It was in an omnibus, passing from Charing Cross to the city. The plate-glass in the shops had dark backgrounds, and became thus the dark chambers of Porta, and everything that passed by was projected by the vision into the shops. It was a perfect phantasmagoria, and it was the plate-glass that produced the effect, "polished like a looking-glass on both sides." I had occasion afterwards to enter a butcher's shop, the front open, and a counting-house in the interior, glazed with plate-glass. Projected into this glass were dozens of ghosts of the sheep and beeves hanging up in front. They were as clean as photographs, and with a similar effect.

Now, this thing has been before the world in a printed book 274 years, but no one has turned it to the account of a public exhibition till Mr. Pepper took it in hand. No one practically noticed it, and it was virtually buried; and therefore Mr. Pepper, supposing he did not himself make it known before applying for a patent, must be regarded in the light of a discoverer, and it is for the interest of the public that he should obtain his patent, as much so as the discoverer of any practical improvement in photography, in order to induce other discoverers to do likewise. The fact that the shadow is projected through glass, and is evanescent, instead of being permanently deposited on it, and that the Ghost *is* a gratification for a large assembly instead of a property for individuals, cannot diminish its utility. Nothing, as we all know, is new under the sun; but no doubt Mr. Pepper at the Polytechnic has given something to the public that they had never had before, and he is fairly entitled to his reward.

W. Bridges Adams.

WATER-PIPES AND FROST.

At Buxton there is much water, and a gentleman residing there, desirous of knowing how to prevent that water from bursting supply-pipes by the action of frost, has written for a specification of the plan indicated by me in a former paper.* Possibly, *apropos* of Christmas weather, a recipe after the manner of Mrs. Glasse may serve for others as well as my correspondent.

We all know that water in motion does not freeze unless under a degree of frost rarely experienced in England. Even in New York the proprietors of the Croton aqueduct enjoin the housekeepers whom they supply to suffer the water to run off as fast as it can during frost, in order to save the pipes from casualties. Now it is possible to attain sufficient motion without wasting the water, by simply inducing circulation by heat. When the ball-cock in the cistern is closed, the water in the pipe above it is motionless. At that point should be attached a small cistern of thin copper, containing, say, a quart or half a gallon of water, which may be a sphere like a ball-cock, or of any convenient form to apply beneath it a gas jet of sufficient power to heat the water and keep up a circulation. If this gas jet be kept constantly burning in frosty weather, the water cannot freeze, and the pipes will not burst. The small heating-cistern must, of course, be placed at the lowest point of the pipe.

W. Bridges Adams.

* See Vol. iii., p. 216.

THE HARTLEY PIT HECATOMB.

Another martyrdom on the altar of England's physical greatness—but this time a martyrdom of peace and not of war! A martyrdom to the wealth and power and health and comfort of universal England—yet more than a martyrdom, in the unmistakeable evidence that multitudes of their fellows were ready to risk martyrdom also to save their fellows from their fate. Let us sorrow for the dead, but let us also honour the living who have dared death in the effort to save them. We pension and medal our soldiers who do daring deeds in the pursuit of war, and we do as much for those who save the lives of drowning seamen. More appalling is the work of the men who dare the perils of the imminent deadly mine: and why should not they also wear a medal of honour as belonging to the Order of Life-savers—attached, if need be, by the Sovereign, or by the highest officers of state?—the Braidwoods of the Coal-mine.

We must do more than this. We must make this martyrdom, as well as other martyrdoms, an incentive to remove the causes of it. We cannot yet dispense with the use of coal, which is synonymous with the existence of England as a great nation—secondary sun's heat—the source of physical power deposited deep down in the bowels of our land—in the great fuel chambers of nature, provided for the growth of freemen in sufficient numbers to produce civilisation of a high order.

Inspection by Government officers can do much, but the result must depend on the individual characters of the inspectors employed. And it would be difficult for Government to determine what mines are safe and what are unsafe, and the conditions of safety. This must be left to the capitalist and the miner to settle, and nothing must be done to interfere with production. But they who work in coal-mines are the servants of the entire nation, and not merely of any small class in the nation. Miners are not commonly money-saving people—but neither are soldiers, nor sailors, nor they who dwell in New Orleans. Where the living is earned by a life of daily risk, quiet and careful thought is scarcely possible.

Slain coal-miners leave wives and families behind them. They should not be left as objects of desultory charity, or come under the category of paupers. A process might be adopted that would be self-acting. The City of London collects a shilling per ton on all the coals brought to London, for mere municipal purposes. Why should not a fraction of a shilling be collected per ton at every pit's mouth to form a fund for the maintenance and education of the wives and families made destitute by the loss of their husbands and fathers? It would not be a tax on coal owners, but on coal consumers—*i. e.*, on all England—and any surplus might be applied, after providing for all needing it, to experimental processes for diminishing risk.

It may be said that there is an injustice in thus taxing the owners of safe coal-mines for the benefit of unsafe ones. This might be met, to some extent, by a premium presented to those coal-owners who had been free from accident resulting in loss of life—the premium being the surplus left upon the tax at the year's end, after providing for widows, orphans, and disabled men, as well as giving pensions to life-savers.

The general accidents in coal-pits arise from mephitic gases. At the Hartley Pit the immediate cause was the breaking of a cast-iron engine beam, an accident which we may venture to say will not occur again; but the breaking of this beam would have been nothing, and the men's lives would have been saved, had the mine been ventilated and pure. The only passage to the open air being stopped, the men were suffocated. It becomes a question, therefore, whether a pit which will not afford two shafts should be allowed to be worked at all.

For generations the gas known as fire-damp has been a source of peril in coal-mines: this gas

and conveniences of all kinds will be constantly on the increase. There are few more probable speculations than this of Mr. Sang, as regards popularity, if he can only show that the cost of the erection, and the ground-rent to the bridge proprietors will not be too heavy.

It may be interesting to know that, some ten years ago, in a conversation with the late Sir William Molesworth, Mr. Sang proposed to convert the present bridge, on a somewhat similar plan, into a picture-gallery; but the government received the proposal with little encouragement, on the ground of the expense, which, after all, would not have been large, while such an arrangement would have enriched London with one of the handsomest galleries in Europe.

W. Bridges Adams.

THE GAS POISONS OF OUR DWELLINGS.

I once made a passage across the Atlantic, "slantendicular" down South, in the old days ere steam was on the ocean, when a vessel of 200 tons burthen was considered a very respectable craft "to sail in all this month" to any port, except those of Eastern India, where "floating palaces" were employed of 800 and 1000 tons burthen. Our craft was a scant 200 tons; but there were some twenty or thirty emigrants on board, men and women, for whom a part of the hold was bulk-headed off and floored with a lot of loose deals—part of the cargo. The women were disposed to be neat in their watery abode, and duly swept it out; but they made a discovery that it was much easier to sweep the dust backwards and forwards over the cracks in the planks till it disappeared than to carry it upon deck and throw it overboard. This process was very distasteful to the mate, who every morning would look over the open hatch, and seeing the operation, would call out, "What! you're 'losing' it again." But his efforts were in vain; and the nuisance became considerable when the slops were thrown down the same crevices, and the mate gave it up in despair. It never entered into the imagination of the good women that they had not lost it, but that it was all there down in the hold helping to increase the bilge water.

Just so is it in our houses. We have dark holes underground in which we try to lose all those substances which are of no apparent use to us. In every house we have one or more sinks. In common acceptation these sinks are a sort of tank whereat servants wash dishes and other things. The etymology of the word we do not study, but it is in reality a hole through which dirty water sinks, and we hope we have lost it. In country towns we find it again running down open drains. In large cities we cover up these drains, and we are satisfied that it is really lost. But not so: it crops out again in the river. So now we make very long drains indeed, and carry it towards the mouth of the river. There it mixes with salt water, or tries to mix, but the sea will not have it, and washes it back again. Like the ancient Britons in their appeals to the Romans for help, it seems to say, "The savages drive us into the sea, and the sea drives us back on the shore." It will not be lost; and now, after flooding the dirty water with clean till the clean grows scarce, they begin to think of giving it decent sepulture in the earth, in the hope of turning it into a very watery kind of grass, convertible into a very watery kind of milk.

So much for the liquids and the soluble solids of our houses which can be made to float away and try to be lost through underground passages in Stygian darkness that cannot be penetrated or even examined save by breaking into it. But there are also solids that are not soluble in water, and which we cannot hope to "lose" altogether. So we find as dark a hole as we can, and we call it a dust-bin. In small houses a favourite place for this is under an internal staircase in utter darkness, or if not, a dark vault opening into an area at the front or back of the house. By the word dust is meant the ash, cinders, and unburnt particles of coal, which was formerly very valuable in brick-making, under the name of breese, probably a corruption from the French *débris*. This matter mixed with brick-earth causes the heat to penetrate easily. In fact, the bricks are burnt by internal heat. But the contents of the dust-bin are by no means dust only, which would be harmless enough, they contain also waste portions of food, positively more injurious to health than the undigested food that has passed through our bodies. In short, the dust-bin is the "kitchen midden," a far worse collection than the farmer's midden, which latter has the advantage of being in the open air. It is composed of bones of animals, damaged cooked meat, fish, wasted cooked vegetables, cabbage leaves, wasted bread, and everything that will not float in water or pass down a sink-grating. And when the bones do not go into the dust-bin, but are kept separate for sale in some closed cupboard, they do not therefore fail to give off their noxious odours separately.

These "kitchen middens" fester and putrefy, and fill the house with poisonous gas. It is supposed that the parish dustman carries them off "Once a Week;" but these good folks are by no means so regular as our publication. They know the value of being free from a nuisance by what people say in the

houses, thinking probably like Mr. Boffin that such people are very fanciful, and they won't come unless they get their "regulars" regularly.

There should be little difficulty in getting rid of our refuse if we only did it systematically. Every day comes into London the food and beverage intended to nourish the bodies of some three millions of people. By boats and ships, and carts and waggons, and railways, this mass of matter arrives, and also through the water pipes. After it has passed through our bodies, it is reduced in bulk and weight by the abstraction of the gases, and the same means that have brought it during the day are more than competent to carry away the exuvia during the night. If valuable enough for the purposes of manure, it should be so carried away night by night, and it should have a receptacle quite separate from that of the coal ashes. We should be surprised how very small a bulk there is, were it dealt with each day, and how very slight a nuisance it would be if not suffered to accumulate beyond the day.

We have tried what the chemists call the wet system long enough. With liquids undiluted the bulk is small enough to deodorise them and run them off to a reservoir, but the huge dilution renders this impracticable, so we turn them into the Thames, or turn the Thames into the sewers. We might try the dry methods with the solids, which are subject to putrefaction. Mr. Glass would say, have a chimney, if of cast iron without the flaws or leaks which brick chimneys are subject to, so much the better. Into this chimney let there be air shafts from all the house drains. Let the lower part of this chimney end in a close furnace, to which gas may be admitted by metre as usual. In this furnace let there be a mouth or hopper to admit coal to be kindled by the gas, so as to give the servant no trouble or motive for shirking. Into the hopper anything capable of creating a nuisance in the solid form may be thrown, and rapidly destroyed, or rather changed into gases and thrown into the upper air, there to play their several parts in creation. A house so treated, with its exuvia burned every night, would be perfectly free from noxious gases of its own production. In country places cottagers keep a furnace of another kind, in the form of a pig, just as the people in Constantinople keep dogs; but we cannot admit pigs into a city in England, and we are not sure that pigs fed on carrion and offal are the best possible human food. We should not like the milk of cows fed on beef tea. In the Pampas of La Plata wild pigs feed on dead mares, as the food of their choice. No one tastes those pigs twice. When caught, and their carrion food is stopped, they will starve for three weeks ere they will touch maize, and it takes many months ere their flesh ceases to exude a kind of lard, smelling and tasting like train oil.

There would be no difficulty in erecting public furnaces for the destruction of noxious substances. Indeed there would be no difficulty in putting such substances into the ordinary gas retorts, and making them into gas; but a wise man would have his own furnace, and use it as the destroyer of his foul air, shutting out the general supply from the public sewers.

As regards the dust proper, nothing can be purer. It is already in the condition to which it is desirable to reduce the animal and vegetable fragments. There is an important use to which the dust can be turned as an antiseptic: this will perhaps be done in time; but meanwhile destruction of noxious substances by fire is the true and safe process. It would be a blessing to the numerous dining-houses in the city to get rid of their offal, if possible, every hour during warm weather, and never suffer it to be thrown into the "kitchen midden," to the horrible disgust of those who pass by their gaping area gratings. If the offal of London were destroyed, or utilised, and never suffered to get into the sewers, a very large portion of the nuisance would be got rid of without much difficulty.

W. Bridges Adams.

THE TRAMWAYS OF LONDON AND ENVIRONS.

It is now thirty years since I beheld the first attempt at steam-locomotives on common roads on the trial of Mr. Goldsworthy Gurney's steam-coach round the Regent's Park. It was a strange-looking machine, on four wheels, with a pair of supplementary wheels in front, to serve as a steering-apparatus. I watched all the subsequent doings of Maceroni, Ogle, and Sumner, Scott Russell, Hancock, and others, and came to the conclusion that the whole scheme was a practical fallacy—an

opinion I have never seen reason to change. The fallacy consisted, and consists still, in attempting to propel a heavy machine by means of revolving wheels on an irregular surface of broken stone, or an irregular surface of paving. Regarding the machines themselves, very considerable results were achieved, more probably than has been achieved on regular railways, taking into account the respective qualities of the roads they run on. And the modern attempts in the form of what are called traction-engines, embody the same fallacy—all, save that of Boydell, which carries and lays down its own rails to provide a hard and even surface for the wheels to run on. The whole difficulty consists, not in the steam-machine, but in the road it runs on—and this conviction, I have, for more than twenty years, in public and private, in season and out of season, endeavoured to impress upon the general mind of the community. It has been my aim to convert the common roads and highways to the purposes of steam-locomotion without interfering with any existing traffic. It was the existence of these roads that set the highway locomotives at work, and finally has led to tramways, the fact of which as applied to passenger-traffic in England, has been established at Birkenhead by an American speculator, stimulating Lancashire capitalists.

By a modern tramway is understood a railway, with the rails so laid on the surface of an ordinary road that they will not interfere with the traffic of ordinary vehicles, and on which omnibuses may travel at ordinary speed with the advantage that, by the improved surface, one horse is enabled to do more than the work of four on levels, and of two on ordinary inclines. The rail is, in short, a continuous "level crossing," which no more impedes ordinary traffic than do the sunken iron gutters in Fleet Street impede pedestrians.

This kind of way began, practically, in the United States, when it was found convenient to pass railway-trains through, instead of round the towns. As a concession to popular fear, the locomotive was at first taken off, and its place supplied by a team of horses. Custom making it familiar, and economy rendering it desirable to get rid of the horses, the locomotives did their work at a slow pace. Then a gibbet was placed across the line on which a bell hung, which the locomotive rung in passing, and a notice being posted up—"Look out for the engine when the bell rings"—all further precaution was abandoned.

Starting thus, it was not a very difficult process to apply to streets for internal transit, and so rails were laid up one narrow street and down another to preserve a continuous circulation of omnibus-traffic. Street omnibuses were a mere imitation of railway-cars—very far from what they might be in the way of easy draught—but answering the purpose, after the usual habit of a Yankee's thought, who goes to plough in a dress-suit, and guesses "what's good enough for my legs is good enough for my trousers." After some years practice in the States, a Frenchman carried the scheme to Paris with all its imperfections, and, I believe, it still goes on there. But to inoculate England with it required a genuine American, and he appeared in the person of Mr. Train, who showed energetically the good folks of Birkenhead the paying chance of the scheme. It is impossible that this result should fail to be followed in London.

It must be understood that a properly laid rail will not, in any way, interfere with the ordinary uses of the street or road—that it will only be a stripe of iron paving substituted for stone—it will subserve all the purposes of wheels running on it, but will not prevent wheels from being turned off it at any point required, without needing the expensive and troublesome appliances called switches and turn-tables used on railways proper. The movement on it may be almost noiseless if rightly managed; the speed may be increased while a larger proportioned load is drawn, and the facility of stoppage, and the resulting safety doubled. The result of this would be an economy equivalent to one half the value of the horses in capital and maintenance, and a greatly increased economy in the maintenance of the road.

This enormous saving will go into the pockets either of the public or the capitalist, or go to increase the wages of drivers and conductors, and other people employed, or be divided amongst all three. Anyhow, it will be a mode of accumulating capital by savings, and no railway yet constructed offers anything approaching the dividend which may be obtained from these new lines if rightly constructed. The obvious reason is, that the roads are ready made to hand without the difficulties and expenses besetting new lines. Gradually the old vehicles will be superseded by the new, and there is yet a farther consideration—the horse will be superseded by the machine driven by steam or some other power. But there is yet more. In the United States horse-railways are simply, as their name implies, street-railways—the ordinary railways supply the other wants of transit. But in England street-railways will be merely the commencement of highway and turnpike roads supplying a want which most ordinary steam-railways do not subserve. For road purposes it is needful to stop and take up at frequent intervals, and trains are not required, but merely single carriages answering the purpose that stage coaches formerly subserved, but with doubled or trebled power of accommodation. All Kent and Surrey and Essex need these lines, and their making would largely increase the value of the property along their borders; but unfortunately this cannot be till an Act of Parliament shall have amalgamated the trusts, or till the parish authorities shall be of one mind. The mechanical question there is no need to argue. If the proper form of rail be adopted, it will simply have the effect of an iron banding inlaid in stone, as plain as the brass banding round a portable writing-desk, and the paving board of a parish has as much right to lay a piece of iron as of wood or stone paving, subject only to actions for damages if their mode of paving inflicts personal injury on passengers,—and laying a tramway in Parliament Street could not be more mischievous than the tramway on Westminster Bridge. But something far better than the existing railway carriages is required to produce the best result in traction and convenience to the passengers.

The cost of these railways made in the most

perfect manner need not exceed 800*l.* per mile, and the low cost is the true reason why engineers generally have not thought it worth while to turn their attention to them. The carriages should be nearly noiseless and free from vibration, in which case the dead weight may be materially lessened. The carriages, besides, must be capable of running on the ordinary road, and leaving the rails or running on them at the pleasure of the driver.

One argument against the system has been founded on the supposition of danger to the public by reason of a street-railway. This arises simply from the term "railway," and the supposed speed involved. But the risk of a railway-omnibus is really far less than that of an ordinary omnibus, from the fact that it runs on a fixed track, and that passengers know what part of the road to avoid, and the breaks applied to the rail-omnibus afford the means of stopping much more rapidly.

With regard to the lines fit for these rails, they exist wherever omnibuses run. Two great radial centres are the Bank and the Obelisk. Others are the railway terminus, Paddington, to the Bank by the two routes—the City Road and Oxford Street and Holborn—Richmond and the line of road to Charing Cross—the line from the Bank to Epping Forest, which should be for ever kept as a wild park to Londoners, or as a ground for shooters to practice in. Across all the bridges to the Surrey hills, destined hereafter to become a southern London, and so in time to give the chance for the low swamps covered by unwholesome dwellings to be again converted to garden-ground.

Say that a thousand miles may be laid down with rails in London and its environs, what would be the best way of accomplishing it? The Parish trusts would not embark capital in it. But it would be a good speculation for a company of capitalists to furnish the rails, and lay them, and keep them in repair per mile, and thus enable the parishes to take a toll on the omnibuses, which would enable them to dispense with a paving rate. Or if they could not legally take a toll, they could make an equivalent bargain by transferring the cost of paving to the rail owners. Only let there be a will and the "way" will follow. W. Bridges Adams.